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Farm Sewage Disposal Devices*

By H. W. Riley

Mem. A.S.A.E. Professor in Charge of Rural Engineering, Cornell University

IT IS not necessary to repeat that the usual sewage disposal system consists of two stages, the first an anaerobic septic tank for the liquefaction of solids, and the second an aerobic filter bed of some kind for the oxidation of the compounds in the septic tank effluent.

The purpose of this paper is to present very briefly the features of design which our experience leads us to consider essential, and the numerical constants to be used for ordinary rural conditions.

The septic tank must be so located and arranged that the sewage will enter it with a minimum of disturbance, pass through it always with uniformly low velocity, and pass out of it without transporting on into the filter any considerable amount of finely divided matter which is always found suspended in the liquid in an active septic tank.

To control the disturbance at entrance the grade of the sewer from the house to the tank should not exceed one-half-inch fall per foot, or, if more is unavoidable over part of the line, the velocity of flow must be reduced by arranging for a run with a fall of not over 1/16 inch per foot for a distance of from 25 to 50 feet located just preceding the tank. The fall from the invert of the inlet tile to the water level in the septic tank should not exceed 1½ inches. The end of the inlet tile should be submerged, the exact distance being unimportant. A cross baffle closely adjacent to the inlet is highly desirable in small tanks to prevent localized currents.

The rate of flow through the tank is sufficiently regulated in average rural domestic systems by providing a net volume of tank below the water line of approximately ten cubic feet per person served, and proportioning the tank so that the cross section of the liquid is approximately square, and the length about twice the width. Subdivision into numerous chambers is not necessary.

The end of the outlet tile should be submerged and a closely adjacent baffle holds back the bulk of the scum and prevents the easy escape of at least part of the finely divided suspended matter.

The type of tank which we have used as fulfilling approximately these requirements is illustrated in Fig. 1 and is constructed on a form shown in Fig. 2.

The filter bed for the usual rural system will consist usually of the upper eighteen inches or two feet of soil, but may be of sand or other material that is lasting and that will afford air spaces between its particles upon which the aerobic bacteria may develop. When soil is used and distribution is secured by subsurface irrigation from tile, we allow in gravelly and sandy soils from ten to twenty feet of tile per person; in light and heavy loams from thirty to fifty feet of tile per person, while in heavy clay an artificial sand bed with special drainage is usually necessary.

Application of the sewage to the filter bed must be sufficiently intermittent and as uniform throughout the bed as possible. For this purpose an accumulation chamber with automatic dosing syphon, as shown in Fig. 3, is unquestionably very desirable construction and, for households of over

*Paper presented at fifteenth annual meeting of the American Society of Agricultural Engineers, Chicago, December 27-29, 1921.

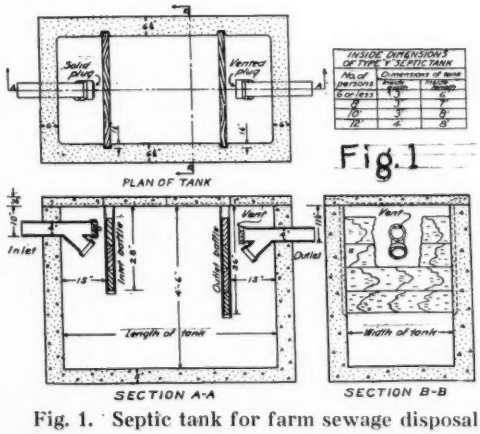

Fig. 1. Septic tank for farm sewage disposal

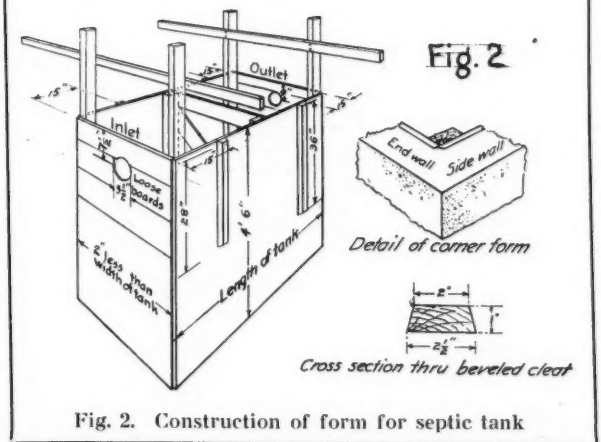

Fig. 2. Construction of form for septic tank

twelve persons, we usually recommend it. The dosing charge is made nine-tenths of the volume of the tile. A distinct advantage of this system is the positive and even distribution with such a velocity of flow that any fine material carried over from the tank and deposited in the tile will be flushed through to the ends of the runs and the tile kept clean. The cost and complexity of construction are distinct disadvantages and an added difficulty is the necessary loss of head which, in level sites, places the tile too far below the surface for best results. To avoid the cost, complexity and loss of head incident to the use of the syphon we have developed the Cornell sewage divider and sewage switch shown in their original forms in Figs. 4 and 5 and illustrated in use in Fig. 6. Each consists of a pair of five-sided concrete blocks, having through the center a Y-shaped channel arranged to connect the inlet pipe with two branches as in Figs. 4 and 5.

In the divider the channel is rounded at the bottom with the result that a stream from the inlet is divided into two almost exactly equal streams in the branches. In the switch the channel bottom is flat and either branch may be shut off at will by means of the plugs in Fig. 5 which are accessible through an eight-inch tile and the hole in the switch cover.

With these two fittings installed, as in Fig. 6, the entire flow may be alternated from one tile bed to another to give intermittency, and the stream may be divided into two, four or eight equal streams, as may be necessary in limited areas.

The details of the forms are shown in Fig 7, and the individual types of blocks in Fig. 8. When assembled in pairs as in Fig. 9, either three-inch or four-inch tile may be used in the hexagonal socket openings. With these fittings, since there is no positive flushing system, the purifying tile are given twice the fall in the first half of each run that there is in the last half. In light soils the grades are ⅛ inch and 1-16 inch per foot; in heavy soils 1-16 inch and 1-32 inch per foot.

The construction of the forms may seem at first glance somewhat complex, but a little study will show that they are really simple. They might well be made in high schools as woodworking exercises, the blocks run as concrete work, and finally put to work as home project work in sewage disposal. In New York state we will insure that the forms are made generally available by building numbers of them and sending one or more of each kind to each farm bureau office.

The divider and switch are recommended to your special attention as substitute devices for the dosing syphon which, by their use, render unnecessary the complexity and expense of the syphon and its chamber, and make possible alternate and uniform sewage distribution without loss of head.

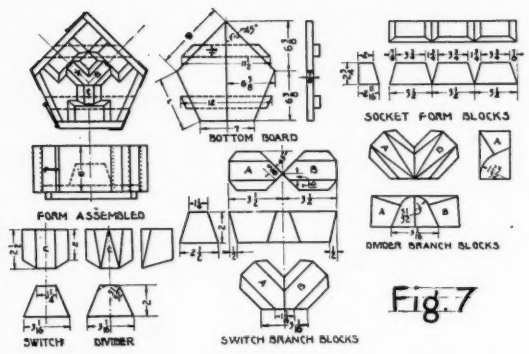

Fig. 7. Details of forms for switch and divider

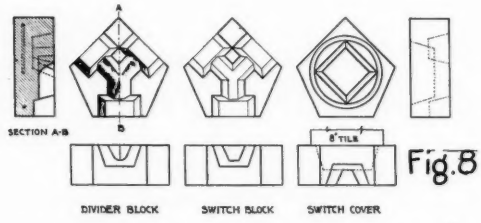

Fig. 8. Details of divider and switch blocks

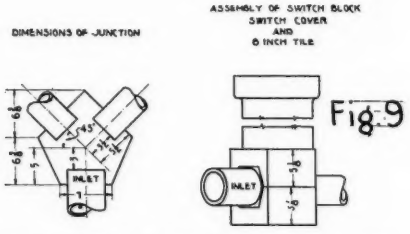

Fig. 9. Installation dimensions of Cornell sewage divider and switch blocks

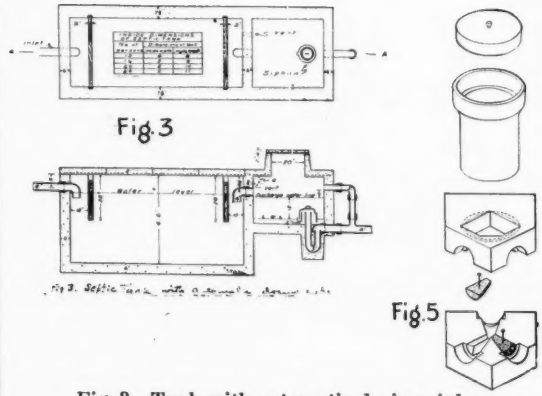

Fig. 3. Tank with automatic dosing siphon
Fig. 5. Cornell sewage switch with tile top

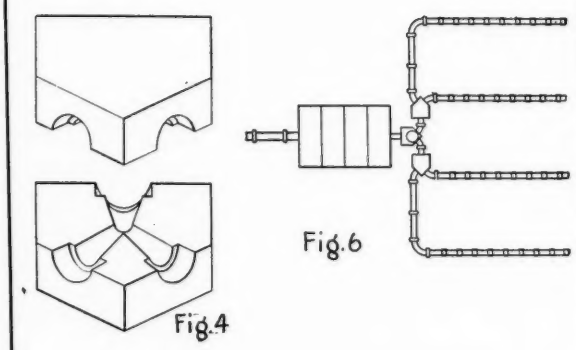

Fig. 4. Cornell sewage divider in perspective
Fig. 6. Sewage switch and dividers in use

Cement Stucco for Farm Buildings*

By J. B. Freeman

Manager, Structural Bureau, Portland Cement Association

ONE of the oldest methods of finishing building exteriors and interiors is by means of a plaster coat known as stucco. For ages the use of stucco has been common in the Mediterranean countries. Some fine examples of stucco work done by the ancient Greeks and Romans are still in existence. Many also may be found throughout Mexico, Central America and the southwestern part of the United States. Some of the last examples, however, are little more than mud plaster with or without lime, used as exterior finish of the mud block buildings erected by the early Spanish explorers and missionaries. In the sixteenth century stucco was an essential part of the half-timbered houses of England, a type of architecture that still prevails there and which has been adapted to the tastes of builders in the United States and other countries.

Until within comparatively recent times the development of stucco in this country has been slow, principally because of the plentiful supply of lumber and the tendency in the past to build with less regard for durability and fire resistance than is evidenced today.

Early builders used stucco to secure added protection against the elements and more artistic appearance at low cost. The same reasons still encourage the use of stucco and in place of mud plaster or cement, builders now have a stronger, more uniform, and more durable material in Portland cement. As the cement can be obtained practically everywhere and the sand and water with which it is mixed are local materials, Portland cement stucco is available anywhere at small cost; consequently, it is being used more and more as an exterior for houses and all other classes of structures, as well as when renovating old buildings of practically all kinds.

Portland cement stucco as an exterior finish may be combined with almost any style of architecture—the Colonial with its stately columns; the Georgian with its simple lines, the Mission with its plain walls and tiled roofs; the Old English with its half-timbered upper stories. The illustrations in existing structures are sufficiently varied to prove the adaptability of stucco and show many pleasing effects that may readily be secured with this material.

Stucco helps to make warm houses where winters are severe and cool ones in hot climates, because the manner of its use increases building wall insulation. The economy and simplicity of its use make it adaptable to workingmen's cottages, large country or city residences, farm buildings, industrial housing developments and many other structures. The intending home builder who carefully investigates and weighs the merits of Portland cement stucco against other kinds of exterior finish, realizes that it will give him more for his money than any other method of treatment and specifies it for his moderate cost city or suburban home.

By adding various mineral coloring materials in proper amounts, many different shades of yellow, red, brown, green and gray can be secured, or by using white Portland cement and white limestone or marble screenings in place of sand, he can obtain a white stucco. Different varieties of sand, marble and granite chips, limestone screenings or other materials may be used in the finishing coat and the surface then treated to expose these selected materials, thus giving choice of many surface effects. Almost any degree of smoothness, roughness or texture is possible, depending on the method used in finishing.

*Paper presented at the fifteenth annual meeting of the American Society of Agricultural Engineers, Chicago, December 27-29, 1921.

Portland cement stucco is ordinarily made on the job from Portland cement and clean coarse sand mixed with water. It can be applied on either metal or wood lath, or directly on any surface of concrete brick, tile or other masonry. The rules for such work are comparatively simple and easy to follow. The cost is reasonable and a building with stucco exterior is a permanent source of satisfaction to its owner.

When the exterior of a house or farm building is of clapboards or shingles, danger to adjacent buildings from fires is great. Even when the house exposed is not actually set on fire, heat may do so much damage that expensive repairs are necessary. An exterior of Portland cement stucco greatly reduces this hazard. Sparks and firebrands are harmless. A fire must be intense, close and long continued before the heat will injure the stucco. This reduction in the fire hazard is particularly important in a building that shelters the owner's family and his personal possessions. Such protection has a real money value. If the roof of the stucco finished house is of cement-asbestos shingles or concrete roofing tile, the hazard from nearby fires is still further lessened.

Portland cement stucco properly mixed and applied is practically permanent. No other stucco will so well endure all climatic conditions from Maine, to California. Maintenance and depreciation are negligible. An exterior of clapboards or shingles must be painted frequently and repairs are often necessary. In a few years the cost of painting and repair amounts to more than the total cost of a Portland cement stucco exterior. When the annual charges for maintenance, interest and depreciation are computed, Portland cement stucco will be found by far the most economical exterior finish.

Old buildings can be renovated or remodeled and completely changed in appearance by applying an overcoat of Portland cement stucco. If weatherboarding is in poor condition it should be removed, then furring and expanded metal or wire lath applied over the sheathing to which sheathing paper has previously been fastened. Another method is to fasten the furring direct over the weatherboarding and then apply the metal lath. In preparation of any of these methods the structure should be gone over carefully to determine whether the framework is strong enough and in good enough condition to produce satisfactory results. The stucco brings an additional weight on the framing. Some provision must be made for extending the old window and door frames to correspond with the increased thickness of the wall or else the plaster brought over the old frames in such a manner that a recessed window or door opening is made.

Where new structures are concerned the best procedure to follow is that outlined by the committee on treatment of concrete surfaces of the American Concrete Institute in their recommended practice for Portland cement stucco issued in 1920. Some of the principal points briefly noted are as follows: Stop the stucco above groundline to avoid possible frost action as well as staining from dirt and moisture. Special attention should also be given to details of flashing and drips. Keep the water from getting behind the stucco.

Masonry walls should be clean before stucco is applied to insure bond. Proper wetting of the surface just before applying the stucco is also important, too dry a wall or one completely saturated—both hinder good results. There should be a moderate amount of suction. Concrete or concrete block walls which are somewhat rough and of course texture

are ideal basis for Portland cement stucco, because of their similar make-up.

Good bracing of frame walls is important to secure sufficient rigidity. Adequate fire stopping is an important feature in this type of structure in order to develop its full fire-resistive value. A basket of metal lath set in spaces between studs at juncture of floor joists and wall or bearing partition and filled with cement mortar or concrete from the ceiling level to four inches above floor level is a good example of effective fire-stopping.

Proper and thorough mixing of ingredients is very important. Only sufficient water should be used to produce a good workable consistency. Once the quantity of water necessary for proper consistency has been determined by trial it should be carefully measured for each batch thereafter. Fine aggregate should be clean and consist of sand or crushed stone screenings graded from fine to coarse, but passing a No. 8 screen. The colorimetric test with which you are doubtless familiar is a very effective means of determining whether a sand is free from injurious amounts of organic impurities. Hydrated lime should be used in the stucco in preference to lump lime, on account of the difficulty of thoroughly slaking the latter on the job.

Mixtures should be about 1:3. Sometimes for base coats a 1:2½ mix is used particularly when plastering on lath. Hair or fibre may be used in the base coat for plaster on lath, but should be omitted in the finish and intermediate coats.

Second coat should follow first or "scratch" coat whenever possible on the day following; the finish coat should be applied not less than a week after the second coat. The second coat should be protected against loss of moisture by sprinkling for two or three days after application and finish coat should be similarly protected from rapid drying.

The wide variety of finishes possible with Portland cement makes it a useful material for the architect in the development of artistic effects, and is one of the reasons why it is so generally utilized by him in residence construction. It is impossible to describe them adequately within the scope of this paper, but they are fully discussed in the recommended practice just referred to.

Where coloring material is added only mineral colors should be used and not over 10 per cent of color by weight of cement should be added. The accompanying table is a guide to the quantities of various colors required for light and medium shades of red, brown, buff, green and dark gray.

TABLE OF COLORS TO BE USED IN PORTLAND CEMENT STUCCO.

COLOR DESIRED AND COMMERCIAL NAMES FOR USE IN CEMENT	Pounds of Color Required for Each Bag of Cement to Secure Light Shade	Medium Shade
GRAYS, BLUE-BLACK and BLACK		
Germantown lampblack[1]	½	1
Carbon black	½	1
Black oxide of manganese	1	2
BLUE SHADE		
Ultramarine blue	5	10
BROWNISH-RED to DULL BRICK RED		
Red oxide of iron	5	10
BRIGHT RED to VERMILION		
Mineral turkey red	5	10
RED SANDSTONE to PURPLISH RED		
Indian red	5	10
BROWN to REDDISH-BROWN		
Metallic brown (oxide)	5	10
BUFF, COLONIAL TINT and YELLOW		
Yellow ochre[2]		
Yellow oxide	5	10
GREEN SHADE		
Chromium oxide	5	10
Greenish-blue ultramarine	6	—

[1]Only first quality lampblack should be used. Carbon black is light and requires very thorough mixing. Black oxide or mineral black is probably most advantageous for general use. For black use 11 pounds of the oxide for each bag of cement.
[2]Should contain not less than 15 per cent of the oxide.

The foregoing discussion is, of necessity, only a brief discussion of fundamental features, and a thorough reading of the recommended practice for Portland cement stucco of the American Concrete Institute is recommended to those desiring more detail information. The Portland Cement Association will be glad to supply copies to those of you who desire them.

In closing I quote the following from a letter by a Pittsburgh architect in support of the statements as to durability and attractiveness made at the beginning:

"In my practice of 36 years in which time I used Portland cement stucco extensively for exterior surfaces, I am convinced that when the material is properly prepared and applied there is no material superior to it for the exterior surface of buildings. There is permanence as well as architectural beauty. My convictions are well based on the fact that upward of a dozen houses of cement stucco on metal lath construction designed in my office and built under my supervision in the early nineties' are standing today not showing the least distintegration."

DISCUSSION

MR. STEWART: Can we really expect the cement stucco on wood or metal lath to last for ten years without developing cracks on the flat surfaces along cracks?

MR. FREEMAN: In the letter just read from the architect in Pittsburgh those buildings which he referred to as having been constructed in the early nineties (1892 or 1893) were of Portland cement stucco on metal lath construction, and examination made by one of our field engineers recently confirmed these statements which the architect made in his letter to the effect that the plastered surface was in practically the same condition as it was when applied. There was a marked freedom from cracks excepting around the coal hole which it might be natural to expect, with coal being shoveled into the building. It depends a great deal upon the character of the framing, the rigidity of the framing over which the lath is applied, as well as upon the care with which the plaster is applied to the lath.

In many cases the tendency might be in applying the plaster on metal lath, not to push it through the lath thoroughly enough. The idea has been that an air space between the sheathing and the plaster on the lath was desirable from the standpoint of insulation, but our investigations would indicate that the tar paper covering over the sheathing is sufficient, and really better insulation than such an air space would be, and if the lath is then applied to pencil rods, that is, quarter-inch rods, as recommended, and the plaster pushed through the lath so it thoroughly covers the lath on the inside, you will have the lathe then imbedded completely in the plaster.

MR. STRAIGHT: A test made by the U. S. Bureau of Standards would answer Mr. Stewart's question, I believe, pretty well. About six or seven years ago the Bureau of Standards built at Pittsburgh quite a large building, in which there were thirty-six separate and independent panels 16 feet square. This building was two stories high, and each one of those panels had separate and independent backing, a different kind of a backing material. They have made observations of each one of those panels about twice a year ever since it was built and the Bureau of Standards have that information.

MR. FREEMAN: The recommended practice for Portland cement stucco to which I referred was based largely on the results of the investigations by the Bureau of Standards, the chairman of that committee being the man who was in charge of those experiments.

Barn Lot Drainage and Barn Sanitation*

By Ralph L. Patty

Mem. A.S.A.E. Extension Specialist in Rural Engineering, South Dakota State College

I ASKED Dr. G. S. Weaver, state specialist in the control of animal diseases of South Dakota, to assist me in this work. He has given his attention to it throughout the season and to him is due most of the credit for investigation. Doctor Weaver has had some twelve years experience in meat inspection and animal disease control work and is a graduate veterinarian. He is an ardent advocate of barnlot drainage.

In visiting hundreds of farms each year, I am impressed more and more with the sanitary advantage of having it dry underfoot for stock raising, no matter whether it be in the barn or in the lot outside. Further, I have observed that the condition of the lot in most cases manifests itself in the barn, and I am certain that it is seldom possible to find a sanitary barn surrounded by wet, muddy lots. On the other hand, I have been on ranches in the drier western region where stables would score very low under the sanitary rules, but owing to their favorable location and dry lots, the health of the stock was excellent and the surroundings were generally sanitary.

Dr. Weaver has the following to say on the subject: "Very frequently hog lots are provided with a mudhole or hog wallow, as many hog owners have an idea that a hog wallow is necessary in hog raising. These hog wallows become infected with all sorts of germs and act as a source of infection for many different diseases. Many farmers have artesian wells and these afford an excellent water supply providing the overflow is properly controlled. If the overflow is left to run through the barnlot in an open ditch, the horses, cattle and sheep tramping through this water, and the manure pile draining into the same ditch, an ideal condition exists for spreading and harboring disease.

It is not definitely known as to how long hog cholera germs will live in such a place, but it is reasonable to expect that they will stay in such a mudhole for at least a year. A very common disease known as necrobacillosis, which affects cattle and sheep in the form of footrot, colts in the form of navelill, hogs in the form of sore mouths and "bullnose," is harbored in all sorts of mudholes and sloughs."—Following are some specific cases of actual disease reported from unsanitary lots by Dr. Weaver:

1. A rancher near Hot Springs, South Dakota, reported a cow that was lame and could not walk. Upon investigation, it was found that this cow was in the habit of standing in a large pool or mudhole in the barnlot. In order to keep the flies off her legs she stood in this pool almost continually and finally became infected with footrot and was then unable to get about. As soon as she was shut off from this mudhole she began to recover with only slight treatment and the mudhole was later drained and no more footrot has developed.

2. A farm owned by John Andrews in Hand County was visited and a diagnosis of hog cholera and necrobacillosis made. This infection was harbored by the overflow from an artesian well.

3. Another farm owned by William Blatzford, Orient, South Dakota, was visited where severe infection after castration was found in the herd. Investigation showed unsanitary mud wallows were directly responsible.

4. It was reported by Phil Jacobson of Rowena, South Dakota, that he was having trouble with his hogs as a result of vaccination against hog cholera. The investigation showed that no hog cholera was present, but, on the other hand, a very bad case of necrobacillosis. This farm had one of the most unsanitary hog wallows seen in several years. In order for the hogs and cattle to get to the watering trough, it was necessary for them to wallow through about one hundred feet of mud. The cattle were all caked with mud up to their knees and practically every hog had a plaster coating all over his body. About twenty of these hogs had died as a result of the disease. As soon as this wallow hole was fenced off the disease conditions improved.

5. A herd of hogs on the farm owned by Earl Cass near Agar, South Dakota, was reported sick. At least two veterinarians visited this herd and diagnosed necrobacillosis, also a complication of swine plague. Dr. Weaver was finally called and found the worst infection of necrobacillosis seen in years. The lot contained an extremely unsanitary hog wallow. The herd was healthy when turned into this lot. When moved to a new dry lot, improvement was soon apparent.

In conclusion Doctor Weaver says: "It is useless to recite further instances, suffice it to say that a majority of all diseased conditions in hogs are due to unsanitary feed lots. At least one hundred and twenty-five cases have been investigated in the last year or so where it was definitely proven that the disease was harbored on the farm where very little

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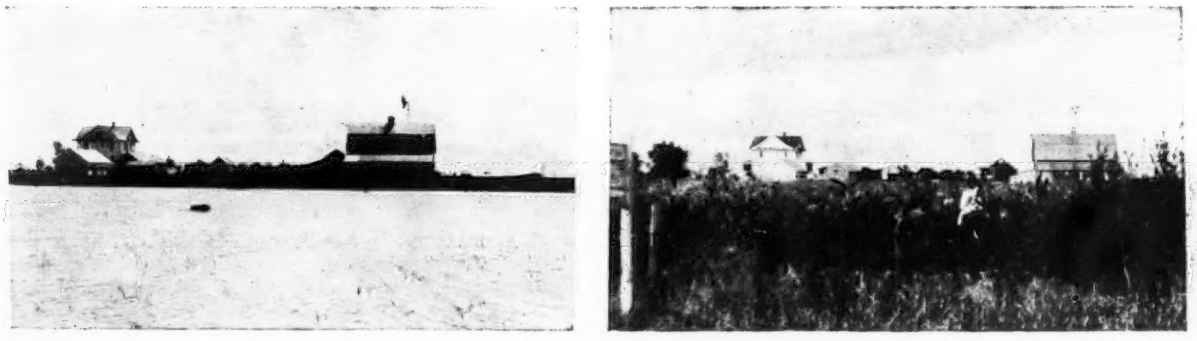

Before and after draining hog lot shown at left in late spring. Beside eliminating disease in the herd there were reclaimed eight acres of $200 land. The job cost $1200, consisting of parallel lines of tile

work in the way of drainage would have prevented this condition."

For dry lots we must depend on drainage, either natural or artificial, plus the removal of litter. It is impossible to secure run-off of the surface water from the barn lot through natural drainage, even though the grade be fairly good, if the litter is allowed to accumulate over the surface, and it is more difficult to lead this water into a tile drain. Dumping the litter carrier onto the ground in the lot is a very bad practice as the litter is soon spread far and wide by the chickens and a muddy, filthy lot is the result.

The problem of draining the barnlot will be affected by the sources of water flooding it. Some of these sources are: Flood water from rains collecting in depressions in the lots; seepage or spring water breaking out on the side hills; overflow water from tanks or artesian wells, and the water falling directly on the lots as rain and running off the eaves of the buildings.

Two of these conditions must be met by cutting off the water at its source, namely, the seepage water and the overflow from tanks or artesian wells. The latter is quite a problem in South Dakota, owing to the large number of artesian wells over the state. Where a basin sheds into the lots the tile should, wherever possible, pick up the water before it settles into the depression. A surface inlet may be used if necessary to cut off or divert this water. We have found this method more effective especially in small lots where the ground is thoroughly tramped by the stock. The puddling effect of this tramping in some soils will make it almost impervious to water. This condition makes a surface inlet necessary, and the surface inlet in the barnlot is usually in the way and difficult to protect. The small hog lot is specially hard to underdrain, as the hogs do an extra good job of puddling and the lot is usually well covered with corn cobs and trash that especially endanger a surface inlet. Another source of water causing muddy lots, especially close to buildings, is the run-off from the eaves of the barn. I do not believe the average man realizes to what extent this contributes to his muddy yards. A concrete gutter for catching this water and carrying it to an outlet or into the tile is usually justified. If the water can be used to advantage it would of course be advisable to install evespouting and supply tank.

Following out the same line of argument, a dry floor in stock barns, including the hog house, is the first essential in sanitation. A smooth, well-drained, non-absorbent floor is desirable. A smooth, masonry floor sloping to gutters of standard design for carrying away the liquid manure gives excellent results. Such a floor is easy to clean and, therefore, encourages more frequent cleaning. It is, also, easy to disinfect. The same material when used in the side walls up to a distance of three feet or more above the floor is both sanitary and practical from the maintenance standpoint, and in the dairy barn this type of construction extending to the ceiling of the stable and offering a smooth surface, without ledges, is desirable.

Repairing Concrete Floor

ONE of the farmers in this county has an old concrete floor that is not properly drained and wishes to build a new floor over it. Would it be possible to prevent the moisture from coming through the new floor if a layer of tar paper were laid on the old floor and the new floor built over it?

L. H. C., Iowa

County Agricultural Agent

Best results will be obtained if ordinary tar is substituted for the tar paper. By using tar paper there may be difficulty in getting a tight bond between the two layers of concrete, but if the old floor can be thoroughly cleaned and hot tar brushed on, it will be easier to get a bond between the old and the new concrete and make the floor waterproof.

Extent of Use of Stump Pullers

Editor Agricultural Engineering:

Will you kindly furnish me what information you have regarding stump pullers? That is, to what extent are they used throughout the United States, in what territories are they most extensively used, and with what success?

Fred K. Babson

STUMP pullers are used quite generally in a large portion of the United States, Iowa, Illinois, Indiana, and other nearby states commonly considered in the prairie belt are large users of capstan type of horsepower stump pullers. In these states, comprising the rich agricultural section of the country, the stump puller is used to remove green oak stumps or other hardwood varieties and for pulling hedge. In the cut-over territory of northern Wisconsin, Michigan, and Minnesota stump pullers are used to a considerable extent, particularly on the lighter and medium types of soil, and where the stumps are largely pine. These pullers are used in combination with dynamite in most cases, as the dynamite explosion breaks up the pieces and removes the soil so that the stump when removed can be handled. Horsepower stump pullers are also used in the southern cut-over district, in New England, and in our Pacific coast states. The use of machinery or explosives for the land clearing in the East and South is not as general as in the lake states or even in the so-called corn belt. In the West the use of larger outfits, particularly donkey engine outfits adapted from the logging work of that section, are more general than in the East or the lake states where the stumps are terribly small. Man power and other special types of pullers are used generally over the country. Of late years three or four types of one-man pullers have been sold in large numbers, both in the West and in the lake states.

The success of the stump puller depends on a great many conditions. In the high-priced land in the corn belt where dynamite is practically unknown and where frequently conditions are not such that it can be used on account of nearness to building, the use of a puller enables an ordinary farmer with horse power to pull out bodily hedges and other green stumps, second growth, etc.

In the lake states stump pullers are successful and recommended in combination with dynamite on the medium and lighter types of soil, and on white, jack, or Norway pine stumps. Only in exceptional cases does the stump puller seem to work so effectively on the hardwood and on the heavy types of soil. Wisconsin land clearing workers recommend the use of the combination of dynamite and stump puller on most land clearing operations. Arrangements are often made to have the stump puller rented to the farmer at a cost per day sufficient to maintain and pay for the outfit.

The hand pullers are often successful in the hands of a man without horsepower, with little money and willingness to contribute his time liberally to get cleared land. Naturally a one-man puller requires that the smaller strength of a man be moved through a great distance in order to get a heavy pull on the stump.

Pullers using engine power have not thus far become very general in use. In the West the old logging outfits are sometimes adapted for stump removal. These seem desirable only where the value of the land is high to justify the overhead and high cost of clearing. Generally increasing taxes and overhead carrying charges on idle land seems to be developing a condition which will require large pulling units and wholesale clearing devices in order to make the land quickly ready for sale.

John Swenehart

Specialist in Land Clearing,
University of Wisconsin

Financing of Drainage Districts*

By S. H. McCrory

Mem. A.S.A.E. Chief, Division of Agricultural Engineering, U. S. Department of Agriculture

IN CONSTRUCTING drainage improvements one of the most difficult questions that those entrusted with the execution of these works have had to deal with in the past few years has been the problem of borrowing money with which to finance them. Changed economic conditions due to the war caused a large increase in interest rates. Many new and attractive securities yielding a very high rate of interest were sold, the result being that drainage bonds with their relatively low rate of interest could not be sold at par, despite the fact that they were exempt from all federal income taxes, and in some states from state taxes. The market for bonds is now improving and interest rates are falling. Present indications are that within the next few months a much improved market for drainage bonds will prevail and that large issues of well-secured bonds can be sold without difficulty.

In every drainage district before construction of the necessary works can be started three things must be accomplished. Legal organization under the laws of the state in which the district is located must be effected, the plan of drainage must be developed and adopted, and arrangements must be made to secure the funds required to pay for the construction of the necessary drains, levees, and other appurtenances.

For the purpose of this discussion, I shall assume that a legal organization has been perfected and that a plan of drainage has been adopted by the commissioners of the district. It now remains to secure the funds necessary to pay for the construction of the proposed improvements. In most drainage districts it is not possible to meet the cost of the improvements by taxes which can be paid in one or two years. Therefore, it becomes necessary to borrow the money which will later be repaid as the drainage taxes are collected from the landowners. To meet the needs of drainage districts a system of financing has been developed that provides for issuing drainage bonds which are repaid from the taxes. Usually bonds are sold by the district to investment bankers who in turn dispose of them to persons or institutions who desire them for investments.

INVESTMENT BANKERS SCRUTINIZE PROJECTS

A drainage bond to be saleable must be issued by a legally organized district whose affairs are in good condition, and the land in the district must be of such a character and of such value as to insure the payment of the bond. Purchasers of drainage bonds inquire closely into the organization of the district and make certain that all requirements of the law have been met before agreeing to purchase the bonds. Generally the purchasers of bonds require the district to furnish a certified copy or transcript of the district record for their examination. This record is examined carefully by an attorney for the purchasers, and if there are any errors or omissions, the purchaser will delay buying until these can be corrected or adjudicated by the courts. To successfully pass this scrutiny the records of the district must be carefully and accurately kept, and every provision of the law under which the drainage district is organized must have been complied with and due record made of each step. Before they will purchase the bonds, many investment bankers also require that an engineer of their own selection shall examine the land in the district and pass upon the plan of reclamation, in order to make certain that the security back of the bonds is of good character and that the plan of drainage is adequate.

The investment banker purchasing the bond usually has an inspection and report upon conditions in the district made by one of his own employees. Their inquiries are apt to cover a broad field. The general reputation of the officers of the district as to business ability and character is ascertained. For this reason, if for no other, it is desirable that the officials of the district be men of good business judgment and high standing in their own community. The past reputation of the community with regard to prompt payment of obligations of a similar character is also given consideration. If after all examinations are completed the reports upon the prospect are favorable and the banker is satisfied with the conditions in the district, he is in position to bargain for the bonds of the district.

SERIAL BONDS ARE MOST ECONOMICAL

In selling bonds to the investment bankers various methods are followed. Some states require that the bonds be sold only after advertisement of the time and place of sale, in much the same manner as in letting other contracts. At such sales the bonds are sold to the bidder who offers terms which the officials consider most advantageous to the district. In other states the bonds may be sold by private agreement or by public sale as the officials deem most satisfactory. It would seem that under the ordinary conditions the method of selling bonds by public sale after due advertisement, is to be preferred. Before advertising the bonds for sale consideration should be given to the type of bond which will most satisfactorily meet the requirements of the purchaser, and be most economical for the landowners.

Three types of bonds are in common use: Sinking-fund bonds, annuity bonds and serial bonds. Sinking-fund bonds are issued to run for a certain definite period and at maturity are to be retired from the proceeds of a sinking fund which has been accumulating during the life of the bond. The fund to retire the bonds is accumulated from the annual instalments of taxes collected from the benefited landowners and the interest on these instalments. These instalments and the interest thereon are so proportioned that the desired amount will be available to retire the bonds at the date of maturity. The interest which the sinking fund draws is usually less than that drawn by the bond. The objections to the sinking fund type of bond are numerous. It is difficult to insure that in case of an emergency the officers of the district will not draw upon the sinking fund to meet this emergency and fail to make arrangements to replace the amount withdrawn, thus resulting in a deficit in the funds necessary to retire the bonds at maturity. In other cases it may not be possible to secure the rate of interest on the sinking fund that was assumed when the bonds were issued. There is also always the possibility of loss due to the failure of the institution in which deposited or embezzlement of some of the funds. The costs of a bond issue of a fixed amount and interest rate when sold at par will in every case be greater when provision is made

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to retire it by a sinking fund than where the annuity bond or the serial bond is used. The sinking-fund type of bond is not to be recommended for drainage districts.

In the case of the annuity bond, the principal and interest are discharged by constant annual or semi-annual payments depending upon the taxing system of the State in which the district is located. The amount of each payment is determined by the rate of interest and the terms of the bonds. The amount of principal retired is small at first, but constantly increases while the interest payments decrease. The total amount of principal and interest paid on the bond issue each year remains constant. This is an advantage in that the authorities charged with the collection of the taxes know how much money must be collected for this purpose each year, and the yearly taxes are the same on each parcel of land during the life of the bond.

Serial bonds differ in form somewhat from the annuity bonds. Instead of keeping the payment of principal and interest a constant amount each year, the amount of the principal retired each year is kept constant and the interest charge gradually decreases. The moneys collected are disbursed soon after they are collected, there is little loss of interest by the district, and the possibilities of loss by embezzlement are reduced to a minimum. The cost to the district of a given amount is less with the serial type of bond than with either the annuity or sinking-fund types. This type of bond has become very common during recent years for all types of public improvements and is probably more widely used at the present time than any other.

A comparison, as between the three types, of the total cost of bond issues for the same amount, bearing the same rate of interest, and sold at par, may be of interest. Let us assume a bond issue of $100,000 for 20 years at 6 per cent, and that in the case of the sinking-fund bond the money in the sinking fund will draw interest at the rate of 4 per cent. The cost of this money to the landowners in the district then will be in the case of the sinking-fund bond, $187,163; in the case of the annuity bond, $174,360; and for the serial bond, $163,000. In other words, the serial bond is about 7 per cent cheaper than the annuity bond and about 15 per cent cheaper than the sinking-fund bond.

The life of a bond is a matter that should have careful consideration. If the term is made too short the annual cost will be high and the landowner will have difficulty in meeting the tax. If too long, the amount of interest that will have to be paid will be greatly increased. Experience has shown that in districts where all the land can be utilized soon after the ditches are constructed, a serial type of bond running for a period of from one to ten years is very satisfactory. For lands not so well developed a life of fifteen or twenty years will possibly be more satisfactory. It is questionable if drainage bonds should ever run for a greater period than 20 years.

In many states it is customary to allow a period of from 3 to 5 years before payments of principal are begun in any district. This is done on the assumption that by that time the work will have been constructed and the benefits of the improved drainage will accrue to the land in the district, thus enabling the landowners more easily to repay the cost of this work. The arrangement is a desirable one and makes the burden of the landowner lighter. It would be well if every drainage law gave the commissioners the option of making such an arrangement when issuing bonds.

UNEXPENDED FUNDS SHOULD DRAW INTEREST

After the type of bond has been decided upon, there arises the question of where the money shall be kept after it has been secured. This is a matter that deserves very careful consideration upon the part of the district officials and their financial advisors. Bonding houses usually would like, if possible, to retain the fund and to make payments to the district only as the needs of the work develop. This is possibly as good an arrangement as any provided that the bonding house does not require delivery of all of the bonds at one time, and that it will allow accrued interest on the bonds

Wheel type of excavator used extensively for trenching before laying tile drains. The economics of this type of trencher have been studied in England with the apparent conclusion that there is little saving in cost as compared with hand digging. Scotch and American experience seems to favor the machine

which are delivered at a date subsequent to the date of their issue.

In some cases districts which have sold bonds have arrangements with the bonding house to allow them interest on the balance at an agreed rate. This arrangement is satisfactory provided ample security for the money left on deposit with the bonding house is given. In other instances drainage districts have loaned the money to local banks for given periods at agreed rates of interest and have required the bank securing the money to assure the repayment by security bonds or other acceptable security. At first thought it would seem that the matter of interest on balances was one of relatively minor importance, but a few computations will indicate that it is a matter of considerable importance to the landowners in the district. I recall one instance where a district issued some $300,000 worth of bonds with an agreement to allow the money to remain with the bonding house without interest until it was needed. A few thousand dollars were spent on organization expenses; but before a contract could be let and construction work started, legal difficulties occurred and the work in the district was discontinued for some three years. The bonding company had the use of more than $250,000 for this period, without expense. The district meanwhile was paying interest on the bonds. Had the money been put out at four per cent interest it would have reduced the cost of the project to the district more than $30,000. Such situations are of course to be avoided.

In cases where the state law does not permit bonds to be sold below a given figure, it is sometimes possible to arrange with the bonding companies to accept bonds at an agreed valuation with the understanding that the funds of the district, properly secured and drawing an agreed rate of interest, are to be left with the bonding house until the district has need to disburse the money. While such arrangements are not to be commended, they sometimes afford the only solution available, and are much to be preferred to making payments to the contractor in bonds for work done, which bonds he later sells at a large discount.

In issuing bonds careful consideration should be given to the dates on which payment of taxes will be made, and the dates upon which the payment of principal and interest on the bonds will fall due. The date of payment of principal should, in the case of annuity and of serial bonds, be after the date on which drainage taxes become delinquent. One would think that the purchaser of bonds would be sure to make certain that funds would be available to pay interest and principal when due, but I recall one instance in which neither the seller of the bonds nor the purchaser gave it consideration, and when the first instalment of principal and interest came due it was found that there were no funds available to take up the maturing obligation as the drainage tax was not yet due. In this case the investment banker and the local banks came to the rescue of the district and arrangements were made to issue funding bonds to provide the funds necessary to take up the payments due.

PUNCTILIOUS PAYMENTS OF PRIME IMPORTANCE

After the bonds have been issued, the officials charged with the duty of collecting the taxes and making the payments of interest and principal when due should make out a schedule showing the payments of principal and interest due each year, the total amount of the taxes that must be collected, and the amount of tax that must be collected from each parcel of land, each year, until the bonds are retired. Every precaution should be taken to make sure that after such a schedule has been prepared the taxes are certified to the proper authority for collection each year. Instances are known where this has not been done, and consequently there was no money on hand when payments came due.

After bonds have been issued and arrangements made to the collecting of money with which to pay them, there remains one important duty—that of paying promptly the several instalments of principal and interest as they become due. It would seem that it should not be necessary to mention this, but frequently we hear of instances where payments of principal or interest have been delayed for very trivial reasons. The person who invests his money in such securities frequently depends upon the income therefrom for his living and it is apt to cause him considerable embarrassment if payments are not made promptly when due.

Some months ago I met a gentleman on a train and in some way the conversation turned upon the relative merits of different types of investments. During the conversation I mentioned drainage bonds as one of the most desirable types of investments, due to the relatively high yield, to their exemption from all federal income taxes, and to the large valuation back of well-selected bonds of this type. Somewhat to my surprise he disagreed with me very vigorously in regard to the merits of drainage bonds and related an experience of his with a block of drainage bonds which he had bought upon the representations of an investment banker. The checks for the interest and principal were never sent by the county officer when due and it was only after repeated requests were made that the money was forthcoming. Upon inquiry he learned that the taxes had been paid promptly and that the only reason that the bondholders were not taken care of promptly, was due to the disinclination of the officer in charge to take care of such payments promptly, he having a feeling that the delay of a few days or a few weeks did not make serious difference. Yet the delay in this case was serious enough to prejudice this investor against drainage bonds to such an extent that he stated he had never bought another lot of them. Almost every investment banker can tell of similar instances. They bring out clearly the necessity of securing for the officers of the district the best business men in the locality. Men who are accustomed to handling considerable amounts of money and to carrying out involved business transactions. Only men who have demonstrated their ability in the business world should be selected for such positions. It is ability to properly protect the district's interest when dealing with contractor, bond brokers, and landowners that is desired—not pleasing personality or political standing—although these are desirable qualifications provided the official has had proper business experience. Bond buyers give careful consideration to the ability and standing of district officials, and the bonds of a district that has strong officers from the standpoint of the buyers are much more desirable than those of a district where the officers are men of little experience or capacity.

The financing of a drainage district, if it is to be done at the lowest possible cost to the landowner (and that should always be the aim of the district official), requires that the provision of the law under which the district is organized be carefully followed; that a detailed record of all action be kept; and that the plan of drainage for the district be carefully worked out by a competent and experienced drainage engineer. In selecting the type of bond to be sold preference should usually be given to the serial type. The life of the bond, the date on which payments of principal will begin, and the interest rate on the bond, should be fixed only after careful consideration of business and agricultural conditions. In selecting the officers of the district the best business talent of the locality should be obtained, as in addition to the problems involved in the sale of the bonds in a manner most advantageous to the district, there will be many other questions come up in connection with the district requiring the exercise of sound business judgment.

Agricultural Engineering Development

A Review of the Activities and Recent Progress in the Field of Agricultural Engineering Investigation, Experimentation and Research

Edited by **R. W. Trullinger**
Mem. A.S.A.E. Specialist in Rural Engineering, Office of Experiment Stations, U. S. Department of Agriculture

THE IMPROVEMENT OF THE LUBRICATING PROPERTIES OF MINERAL OILS, J. H. Hyde, [*Engineering*, (London), 111(1921), No. 2893, pp. 708-709, figs. 10: abs. in Science Abstracts Sect. B—Electrical Engineering, 24(1921), No. 286, pp. 486, 487, New York.] Studies conducted at the National Physical Laboratory of Great Britain on the influence of adding fatty acids to mineral oils are reported. Tests were conducted with mixtures of mineral oil with varying percentages of (1) rape oil containing 2.44 per cent of free fatty acids, (2) neutral rape oil, (3) rape oil fatty acids, and (4) best commercial oleic acid. A Deely testing machine was used, consisting essentially of two opposing friction surfaces, the lower in the form of a disk and the upper consisting of three pegs equally spaced in a circle on the under side of a rotating carriage. The pressure between the two surfaces is varied by loading the carriage with suitable weights. Readings were taken at loads corresponding to intensities of the pressures of 20, 40, 60, 80, 100, and 120 pounds per square inch.

The coefficient of friction was found to be constant in most cases over the range of loads tested. A very considerable reduction in the value of the static coefficient of friction of the mineral oil was effected by the addition of as little as 1/10 of 1 per cent of fatty acid, whether added as pure oleic acid, acid rape oil, or as rape oil fatty acids. Of the three methods tried, the addition of the rape oil fatty acids proved the most effective in this respect.

Increase in the proportion of rape oil produced further decrease in the coefficient of friction, and the value obtained for the 8 per cent mixtures (0.2 per cent acidity) was 0.099, for the 20 per cent mixture (0.5 per cent acidity) 0.093, and for the 40 per cent mixture (1 per cent acidity) 0.087. The coefficient given by the rape oil alone was 0.081. The addition of pure oleic acid in place of the rape oil gave very similar results.

The results obtained by the addition of the rape oil fatty acids showed a greater reduction in the friction than those of the rape oil and oleic acid mixtures. The value was reduced from 0.132 to 0.087 by the addition of only 0.2 per cent of rape oil fatty acids, but a similar reduction required 40 per cent of rape oil (acidity of mixture 1 per cent), 2 per cent of oleic acid, or 85 of neutral rape oil. Repeat tests were made on the straight mineral oil and on the acid rape oil at the conclusion of the experiments, and results agreeing within 2 per cent of the original values were obtained. An apparent variation of the results with time is noted, which is being further studied.

Comparative studies were conducted on the Daimler-Lanchester worm gear testing machine using mixtures of mineral oil with oleic acid. The pure mineral oil gave an efficiency of the gear of about 96 per cent, corresponding to a coefficient of friction of 0.02. When sufficient oleic acid was added to make a mixture of 0.2 per cent acid, the efficiency was raised to 96.4 per cent and the coefficient of friction reduced to 0.018. After cooling more acid was added bringing the mixture up to 2 per cent acidity. The gear then gave an efficiency of 96.6 per cent, corresponding to a coefficient of friction of 0.017. Pure rape oil gave a constant efficiency of 96.7 per cent or a coefficient of friction of 0.0165.

HOG HOUSES FOR NEBRASKA, O. W. Sjogren and I. D. Wood [Nebraska Station Circular 14(1922), pp. 20, figs. 19.] The material contained in this bulletin is a culmination of several years of study and investigation of the different types of hog houses used in Nebraska. Diagramatic illustrations are given to bring out the essential factors established by the investigation and to serve as a guide in planning houses suited to particular conditions.

It has been found that colony hog houses should be provided with rigid concrete foundations extending from two to three feet beneath the surface. The top width need not be greater than 6 inches in most cases while a nine inch bottom width will be sufficient. Clay building tile laid flat and covered with an inch of concrete makes a very satisfactory floor for farrowing pens. Solid concrete is too cold and damp for use in the pens but makes a very good alley floor. Plank is often used in cheap construction and makes a fairly satisfactory floor if placed upon a layer of sand.

All partitions and pen fronts should be made removable if possible. This permits the use of the entire house for a feeding floor or as sleeping quarters for stock hogs. A well-constructed guard rail prevents a sow from killing young pigs by squeezing them against the walls as she lies down. It should be placed eight inches above the floor for small sows. For larger sows this height may be increased to ten inches. It should extend at least eight inches out from the wall. The small outside door leading from the house to the outside pen should be high enough to permit a sow to pass through without striking her back. This will be thirty-two inches for young sows and forty inches for aged sows.

In case of February or early March pigs it is often desirable and necessary to heat the house by some means. Steam or hot water heat may be used, but these will require a money outlay which will not be justified except in very large houses which could not be heated satisfactorily in other ways, or in the production of high-priced purebread stock. An effective and cheap method of heating used by some breeders consists of a modified hot-air-furnace system. A pit is constructed beneath the center of the house large enough to give room to an ordinary heating stove and a small amount of fuel. This stove is surrounded by a sheet-iron jacket, above which is an opening in the hog house floor through which the heated air is admitted. Cold-air returns are located at the extreme ends of the house so that a circulation of the air is effected when the heat is used. A heating stove may be used in the house with a fair degree of satisfaction.

Details of construction and bills of materials for several houses are presented, together with a sunlight chart showing the slope of the sun's rays at noon at various times of the year for parallels 40, 41, and 42.

REPORT OF THE LUBRICANTS AND LUBRICATION INQUIRY COMMITTEE [London: Department of Scientific and Industrial Research, 1920, pp. 126, pls. 43.] This report consists of an analysis of the problems involved in the field of research on the relation between viscosity of lubricants and the load on a bearing and the action of lubricants at high temperatures as applied to commercial methods of oil testing. As a result of this analysis suggested schemes of research are presented which it is thought will lead to valuable results.

Twenty appendices are included comprising the reports of the individual researches conducted upon which the main report is based. The apparatus and equipment used are described in detail as well as the methods developed. The report is based largely on the results obtained with the so-called Lanchester worm gear testing machine. This machine is capable of measuring the efficiency of transmission of power through the gear with an accuracy of 0.2 per cent by a direct measurement of the ratio of the torques in the worm shaft and the worm wheel shaft respectively.

The values of the speed of the gear and the temperature of the oil under test were noted in every case. After acquiring the correct speed in any test the gear case was balanced and the ratio of the torques observed carefully. The balance was then maintained until a higher temperature of the oil was reached when readings were again taken. This procedure was repeated and if higher temperatures were necessary than those obtained after continuous running of the machine, heat was applied to the oil tank artificially.

In the case of all the mineral oils tested it was found that when a certain temperature of the oil was reached, called the critical temperature, the running of the gear became decidedly unsteady and a marked increase in the rate of the fall of efficiency with temperature was observed. Experiments beyond the critical temperature were continued until it was considered that the test could not be carried further without causing injury to the gear.

In the case of animal and vegetable oils no critical stage was reached at temperatures below 75 degrees Centigrade. Castor oil gave the highest efficiency at the particular load employed. With this lubricant the efficiency remained constant at 95.6 per cent at temperatures from 30 degrees upwards.

Rape and trotter oils were next to castor oil in order of merit. The efficiency was practically constant and equal to 95 per cent for both these oils. Sperm oil showed a gradual decrease in efficiency as the temperature rose, but appeared to attain a steady minimum value at 65 degrees. The efficiency of sperm oil at normal temperature was as high as the best lubricant used but fell off as the temperature rose. All the mineral oils tested showed the characteristic of a marked drop in efficiency at a particular temperature. The tests showed that there is an appreciable increase in efficiency (2 per cent) in raising the pressure from 0.5 to 2 tons per square inch, and there is an increase of efficiency in raising the speed of the worm shaft from 500 to 1,500 revolutions per minute.

The addition of rape oil in any proportion to mineral oils did not appear to increase the efficiency very appreciably (0.2 per cent was noted), but the critical temperature of the oil to which the addition of rape oil was made was raised. The raising of the critical temperature was obtained with the addition of as small a quantity of rape oil as 2.5 per cent, and increasing the quantity up to 25 per cent did not appear to make any further improvement.

Experiments were made to ascertain the effect of the addition to the oils under test of colloidal graphite in the form of oildag. In the case of animal and vegetable oils the effect of the oildag on the oil was beneficial, but was so small as to be hardly appreciable. In the case of mineral oils, beneficial results were found in four out of five samples while in the case of the remaining sample no beneficial effect was observed.

The results of these tests showed that the addition of colloidal graphite to some mineral oils (apparently inferior) may make them as efficient lubricants as superior mineral oils under the particular circumstances obtaining in the worm gear test.

Further experiments were made by adding natural flaked graphite to the oils. The graphite used was of remarkable purity and very nearly free from mineral matter. In the case of animal oils there was an appreciable improvement in the efficiency due to the addition of flaked graphite, but in the case of vegetable oils no change was detected. With mineral oils two samples were improved and two other samples were not affected. In no case did the addition of natural graphite produce a reduction in efficiency, but there was evidence that the wear on the gear was greater.

The various results obtained from tests with the Lanchester gear considered in connection with the values of the viscosity of the oils employed and in connection with pressures of the order of those obtained in the gear in other studies failed on comparison to reveal any evidence for the assumption that the frictional resistance of the gear is dependent on the viscosity of the lubricant alone. This was forcibly brought out in the comparison of the results for castor and trotter oils. At pressures of the order of those obtaining in the gear the viscosity of castor oil at 40 degrees was approximately six times that of trotter oil at the same temperature. In the tests, however, the frictional resistances were found to be approximately the same in both cases.

It was shown that the addition of deflocculated graphite to a mineral oil of relatively low lubricating value produces a marked improvement in its lubricating properties, whereas its addition to an oil of high lubricating quality produces very little effect. In this way it appeared possible to convert all the mineral oils tested into lubricants of approximately the same value for the class of gear in question.

TOTAL SENSIBLE HEATS OF ENGINE FUELS AND THEIR MIXTURES WITH AIR, R. E. Wilson and D. F. Barnard, IV [*Journal of the Society of Automotive Engineers*, 10(1922), No. 1, pp. 65-68, figs. 5.] This article describes certain approximate methods used in the Massachusetts Institute of Technology in determining the total sensible heat content of internal-combustion-engine gasoline and kerosene and their mixtures with air at temperatures up to 500 degrees centimeter (932 degrees Fahrenheit). The resulting data are presented in such form as to make it readily possible to calculate with sufficient accuracy for all practical purposes the resultant temperature of an air-fuel mixture when the temperatures of the two constituents before mixing are known. When combined with the data on the dew points of various fuel air mixtures this information is considered to be valuable in determining the proper conditions for securing a completely vaporized mixture of air and fuel in various types of carbureter and heated manifolds. The results are also taken to indicate that the net effect of the compression stroke in an engine is to vaporize rather than to condense the fuel and that the most difficult problem in connection with the vaporization of the fuel is to secure distribution.

WOOD CONSERVATION AND IMPREGNATION, F. Moll [Holzkonservierung und Impragnierung, Berlin: Holzmarkt, (1920), pp. 2+99, figs. 42.] This publication deals with the preservation of wood as a structural material and contains chapters on the properties, uses, and enemies of wood, protective measures other than treatment, treatment with organic substances, development of impregnation with tar and other compounds under pressure, impregnation with salts, wood coloring, and structural uses of impregnated wood. A bibliography is included.

A. S. A. E. and Related Activities

Irrigation Committee Program

THE chairman of the Irrigation Committee, Dr. Samuel Fortier, associate chief, division of agricultural engineering, United States Department of Agriculture, reports that his committee has a definite outline of work well under way. Each member of the committee has been assigned a specific task, for which he is particularly well qualified, because of past experience, to carry out. The subjects assigned and the members appointed to undertake these tasks are as follows:

(1) The Legal Difficulties Confronting the Development of the Colorado River, G. E. P. Smith; (2) A Well in the Desert, F. L. Bixby; (3) The Peculiar Drainage Problems of Imperial Valley, California, W. W. Weir; (4) Consolidating Irrigation Ditches, L. M. Winsor; (5) Irrigation Outlook of the Great Plains Area, George E. Johnson; (6) The Lesson of the Drought in Montana, H. E. Murdock; (7) Drainage and Supplemental Irrigation for the Willamette Valley, Oregon, W. L. Powers; (8) Utilization of Seepage Waters in South Platte Valley, Colorado, Ralph L. Parshall; and (9) Exchange of Irrigation Water in Northern Colorado, R. G. Hemphill.

Mr. Parshall is in charge of the cooperative irrigation work of the U. S. Department of Agriculture in Colorado and Mr. Hemphill is in charge of the same work in Texas. Mr. Parshall has just completed an extensive investigation costing thousands of dollars in determining the return seepage flow to the South Platte River. Results are being published by the Colorado Agricultural experiment station. Mr. Hemphill some time ago prepared a report covering irrigation investigations under the Cache la Poudre River of northern Colorado, a report of which is being published by the government. An interesting feature of this work was found to be the exchange of irrigation water among the various organizations and users, and it is this particular feature to which Mr. Hemphill will give particular attention.

Mr. Weir, of the University of California, has devoted considerable time to a study of the drainage problems of the Imperial Valley of that state. Prof. Smith of Arizona has followed closely the plans for developing the Colorado River, and is in position to give interesting and valuable information on the legal difficulties connected therewith.

Commercial Engineering Conference

THE second public conference on commercial engineering was held May 1 and 2, 1922, at Carnegie Institute of Technology, Pittsburgh, under the direction of the Committee on Commercial Engineering of the U. S. Bureau of Education. At this conference the American Society of Agricultural Engineers was represented by R. C. Cosgrove, manager of the farm extension division of the Westinghouse Electric & Manufacturing Company.

According to Mr. Cosgrove's report nothing very definite was accomplished at this meeting, the main difficulty being that the speakers had a different conception of what commercial engineering is. For the most part the discussions centered around industrial engineering, and there was also considerable reference to the term "Application Engineering" as being commercial engineering.

The discussions for the most part were in the nature of what the educational institutions should teach the engineers on commercial subjects and what should be included in the arts course in the way of technical subjects. The attendance at the conference was made up for the most part of professors from the various educational institutions. Nothing of particular interest to the American Society of Agricultural Engineers was taken up.

Executive Board of American Engineering Council Holds Successful Meeting

WHAT influence, accomplishment and outlook may be characterized as the most successful meeting in the history of the executive board of the American Engineering Council of the Federated American Engineering Societies came to a close at Pittsburgh, Saturday evening, May 27. Reports of officers and committees, the address of the president, and the declarations of board members descriptive of organized engineering conditions in their respective regions were so encouraging as, in the opinion of the engineers, to justify the conclusion that the Federation had progressed to the point where its permanence and growth were beyond question assured.

Pres. Mortimer E. Cooley presided and, in an account of his tours throughout the country, said that everywhere he found evidence that the Federation idea was growing and that substantial accretions to membership might be expected in the near future. Registration of engineer, employment, federal water power, government reorganization and reforestration were among the leading topics disposed of by the board after discussions more thorough and more inspiring than at any board meeting yet held.

One of the most important acts of the board was the adoption of the report of the Committee on Registration of Engineers, of which Col. Arthur S. Dwight of New York is chairman. The report as adopted contains the statement "that the reasons which justify the registration of engineers responsible for public work do not apply to mining engineers." It follows:

"In considering matters of government as affecting the engineering profession of the United States, the ancient principle which states 'that country is governed best which is governed least,' has been accepted by your committee as representing ideal conditions, and it holds that in an ideal social organization, where man can be left free to follow the trend of his individual bent without resulting injury to his fellow, each should be free to follow such calling as he may adopt, without state interference or regulation.

"Engineering in the United States under absolutely untrammeled conditions in the past, has developed effective skill and a high degree of constructive ability among its practitioners, during which period the provisions for safety have been adequate under average conditions, and the failures which may have occurred have not been rated serious enough to demand legal control.

"Within the past few years, however, a widely supported movement had appeared, resulting in the passage of laws requiring licensing or registration of engineers in various states, and attempts at similar legislation in others.

"It is, therefore, a condition and not a theory which is before the engineering profession for consideration, and the

F. A. E. S. should decide whether it will lend the weight of its advice upon principle only or will accept and travel with tendencies.

"The registration or licensing of engineers with consequent elimination from practice of all not registered, can be supported upon only two grounds: (a) the benefit of the profession and (b) the good of the public.

"Your committee has grave doubts whether licensing can benefit the profession enough to justify the cost and annoyance of the proposed measure. Further, your committee holds it would be beneath the dignity of Engineers to fence themselves against qualified competition by the artificial barrier of the statue.

"Your committee, while recognizing that required registration might not have been recommended ab initio believe that the plan has now reached such development as to deserve consideration and possible direction by the F. A. E. S. (or A. E. C.)

"Therefore

Your commitee recommends to the A. E. C. (F. A. E. S.) an expression of opinion that such legislation may properly cover engineers and architects charged with responsibility for public works.

Your committee is agreed that the reasons which justify the registration of engineers responsible for public works do not apply to mining engineers.

Your committee is unable to agree as to the wisdom or unwisdom of registration of engineers engaged in other classes of work.

Registration laws should provide reciprocity of registration admitting to practice engineers registered in other states and should further provide for the admission to practice of properly accredited engineers from states having no registration laws.

Registration laws should provide for classified registration, that the certificate may indicate those branches of engineering in which the registrant is qualified to practice."

The Employment Service now maintained by the Council in New York and with which volunteer committees in a dozen cities are cooperating to relieve conditions caused by the general business depression, will, it was decided, be turned over to the administration and control of the four founder societies.

The Committee on Regional Activities reported that it had not yet prepared to approve a general plan for the affiliation of local or state organizations but giving consideration to the subject. The committee, of which Gardner S. Williams, of Ann Arbor, Michigan is chairman, recommended "that whenever a general or special investigation is being conducted under the auspices of the American Engineering Council involving local investigation in a community whose engineering organization is a member of the F. A. E. S. the service of such engineering organization be utilized so far as possible in the work in its locality.

The board announced plans proposing the solution of the national problems of water power and forestry, upon which "the industrial development of the nation and the standard of living of future generation largely depends."

The whole federal water power situation is in so critical a condition that immediate constructive action by the government to conserve the public interests, involving vast consequences of economic and federal policy, is necessary the engineers declared. After a long discussion in which the water power problem as it affects government reorganization was reviewed, and into which Henry Ford's Muscle Schoals entered, the board decided to lay the entire question before President Harding.

The resolution adopted by the executive board directs the Council's Committee on Water Power, of which Col. J. H. Pinney, of Washington is chairman, to place before President Harding the facts of the situation with regard to water power development in this country. The board's action at this time, it was stated, was prompted by the Federal Water Power Commission's lack of effective and permanent personnel.

A national movement to conserve the nation's forests, in which engineers, the U. S. Forestry Service, the forestry services of the states, universities and technical schools, and other groups such as the farmers, the railroads, and lumbermen, shall pool their efforts, was set in motion by the engineers. The work will be in charge of a Reforestration Committee of the Council headed by Charles H. MacDowell, of Chicago.

Moving pictures interests will be asked to aid in arousing popular interest in the need of saving the nation's forests and a conference to bring this about is planned between Will H. Hays and Pres. Cooley.

Reports on the forestry situation in Maine, Michigan, Massachusetts, New York, North Carolina, Alabama, Georgia, Idaho, Indiana, Iowa, Rhode Island, Tennessee, Ohio and Oregon were received.

President Cooley asserted that there was 85,000,000 acres in the United States that were fit only for wood and that there were 245,000,000 acres partly fit for wood. In Georgia, Alabama, South Carolina, Mississippi, Louisiana, Arkansas and Texas, he said, there was an area equal to Georgia, Alabama, and Mississippi once occupied by forests now denuded and of which only 20 per cent are now available for agriculture.

The board pledged its support to President Harding in his plan for government reorganization.

Progress in a national survey of the two-shift day in American industries was reported by the Council's Committee on Work Periods in Continuous Industries. This survey, called the most extensive of its kind ever made, has been in progress for more than a year, and purposes an exposition of industrial conditions which shall form a basis for establishing the relative merits of three shifts of eight hours each and two shifts of twelve hours each.

Dr. H. E. Howe of the National Research Council, Washington, is chairman of the committee, which has, it was announced, investigated and accumulated an enormous amount of data in the metal industries, glass and cement, lime, brick and pottery, the chemical industry, sugar, salt and petroleum, cottonseed and other vegetable oils; paper, flour, rubber, miscellaneous manufacturers, mines, electricity, gas, water, ice; transportation, communication, care-taking and personal service.

The report evoked a prolonged discussion among the engineers, who met at the William Penn Hotel, and finally the Executive Board voted to refer it to the Committee on Procedure, of which Calvert Townley of New York is chairman. The committee will direct the work of putting into shape for publication the huge mass of material contained in the findings and will report the result of their work at the next meeting of the board. The gathering and preparation of this material in form available to the general public was declared to be one of the most momentous tasks ever carried on under the auspices of American Engineering.

The steel industry came in for consideration, and it was announced that progress is being made in an investigation to determine methods of covering steel plants in engineering aspects as to metallurgy and production from two to three shifts. Approval of Bradley Stoughton of New York formerly secretary of the American Institute of Mining and Metallurgical Engineers, as director of this field study was voted by the Executive Board.

The question of the program of Frank A. Vanderlip, New York banker, regarding reconstructing Europe was brought before the board by Edwin Ludlow, mining engineer and

operator of New York, and was referred to the Council's Committee on Procedure.

The national problem of flood control was described as of vital importance, and it was decided to cooperate with other agencies in finding a solution, involving the establishment of a national hydraulic laboratory. The recent disastrous floods along the Mississippi caused the question to be brought before the engineers. Senator Ransdell of Louisiana and John R. Freeman of Providence, R. I., it was announced, are at work devising general plans upon which a comprehensive investigation of the whole problem may be based.

The board voted continued cooperation with the numerous organizations interested in types of government contracts A study was directed of a proposed form of universal contract agreement as applied to railroad construction and drafted by a joint conference on standard construction contracts.

Another proposal coming before the board contemplated plans to promote industrial development by the expansion of the country's electrical energy. This proposal, on which no action was taken, originated with Herbert Hoover, first president of the American Engineering Council.

President Cooley presented a plan for more intensive organization of engineers, it being the aim of the Council to bring into the Federated American Engineering Societies all societies of professional engineers welding them into a single unified force which will constantly be at the service of the nation in all matters affecting the public interest in which engineering enters.

Committees, it was stated by President Cooley, are at work on a general policy of affiliation of American engineers with the engineering bodies of other nations. A movement is now on foot, it was said, and is being led in London by Sir Robert Hadfield, famous scientist, to form an Anglo-Saxon union of engineers which shall include the English speaking peoples of all countries. This movement resulted from the close cooperation of British and American engineers during the war.

Successful accomplishments of the study of business cycles conducted by the Council with the assistance of 150 engineering groups and in cooperation with the Department of Commerce was reported. The data gathered is now being compiled in Washington and will be available to further the plans of the President's Committee on Unemployment in its study of a cyclical depressions.

Reforestration, jurisdictional awards in labor, patent legislation, an International Engineering Congress, aerial research, engineering representation on the Civil Service Commission, foreign relations, waste in agriculture and plans for more intensive engineering organization, as proposed by Herbert Hoover, were other topics before the Council, which contemplates closer and more active cooperation with the Federation government in public questions involving engineering experience.

A report from the Patents Committee of the Council headed by Edwin J. Prindle of New York voiced opposition to the Stanley and Ladd bills as detrimental to American invention and industry.

New Members of the Society

MEMBERS

GEORGE RAY BOYD, senior drainage engineer, Bureau of Public Roads, U. S. Department of Agriculture, Ashland, Virginia.

FRED J. BULLOCK, purchasing agent, Papec Machine Company, Shortsville, New York.

WALTER A. WATTS, chief of experimental department, Massey-Harris Company, Ltd., King Street West, Toronto, Ontario, Canada.

JUNIOR GRADE

FRED R. WILEY, 805 S. Second Street, Champaign, Illinois.

TRANSFER OF GRADE

P. J. VENKAYIAH, P. O. Narayaupet, Via Kistna, G. I. P. R., India.

(From Associate to Member)

Applicants for Membership

The following is a list of applicants for membership received since the publication of the May issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to the applicants for the consideration of the Council prior to their election.

Clark Ellsworth Jacoby, President, Clark E. Jacoby Engineering Company, Shukert Building, Kansas City, Missouri.

EMPLOYMENT SERVICE

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members, as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

The Secretary receives several times each month from The Federated American Engineering Societies a bulletin listing the "positions open" which are reported to the F.A.E.S. Employment Service by member engineering societies. Copies of this bulletin are sent to the "men available" listed below, or other members seeking employment, as soon as received.

Men Available

AGRICULTURAL ENGINEER wants position as experimental agricultural engineer or with some agricultural publication. Graduate, 1918, agricultural college of the University of Illinois. Was editor of the Illinois agricultural students publication in his senior year. For two years employed by an explosives manufacturer as agricultural sales and service man for the State of Wisconsin. At present associated with the land clearing department of the University of Wisconsin. Age 25, married, American. MA-101

AGRICULTURAL AND CHEMICAL ENGINEER, with several years experience in research and experimental work, both in agricultural and chemical lines, desires a position on an agricultural experiment station staff or in some phases of agricultural engineering work. MA-102.

MECHANICAL AND ELECTRICAL ENGINEER, graduate of Cornell University and Armour Institute, with nineteen years of practical experience in designing, manufacturing, and marketing gasoline engines, automobiles, motor trucks and tractors, having specialized particularly on internal-combustion motors and their application, prefers mechanical work cooperating with the different manufacturing and sales departments along the lines of sales engineering, or other work into which his qualifications would fit. MA-104

AGRICULTURAL ENGINEER wants position in southwest. Graduate of University of Illinois 1915, five years practical experience on Illinois farm with power equipment, two years in charge of the agricultural engineering department New Mexico College of Agriculture; considerable garage experience and service experience on unit power and light plants. Also one summer in Philadelphia battery service station. MA-106

AGRICULTURAL ENGINEER, graduate from the agricultural engineering course of the Iowa State College, who has had a great deal of experience in sewer work and farm building construction in the southern states, is interested in securing employment with a firm specializing on farm structures or farm sanitation. MA-107

AGRICULTURAL ENGINEER, graduate in agriculture at Cornell and trained in mechanical and electrical engineering, at present assistant professor of rural engineering at an agricultural college, wants position in the same or related field. Six years teaching experience and about six years engineering experience with telephones, milking machines, field machinery, concrete pipe making machinery and gas engines. Thoroughly trained in automotive theory and practice, including repair. MA-108

AGRICULTURAL ENGINEER wants position on a farm or with some firm where an engineering and general agricultural training is required. Will graduate from the agricultural college of the Ohio State University in June 1922. Major work done in agricultural engineering and farm management. Born and raised on farm. Age 22. Unmarried. MA-109.

AGRICULTURAL ENGINEER, graduate in mechanical engineering at Michigan Agricultural College, desires position teaching all kinds of farm machinery or automotive work, or with some farm-equipment manufacturer. Will be available April 1, 1922. Has served one year as instructor in tractors and trucks, and one year conducting service schools for a leading tractor manufacturer. Can furnish best of references. MA-110

AGRICULTURAL ENGINEER, graduate of Iowa State College 1920, with several years of practical experience farming with machinery and one year's teaching experience in high school, wants employment on a large farm or in college teaching of power farming. Twenty-five years of age. Married. MA-111

AGRICULTURAL ENGINEER, with eleven years' experience in agricultural engineering instructional and extension work, is available for position. Graduate of Agricultural College of University of Nebraska. Has had farm experience. Age 38. Married. MA-112.